CS 465

Homework

① a) BEQ Instruction uses:
Imem, Add, Reg, ALU, Sign-extend, shift 2
400 + 100 + 200 + 150 + 50 + 30 = 930 ps

b) ADD uses: Imem, Add, Reg, ALU, D-Mem

400 + 100 + 200 + 150 + 500 = 1350 ps

c) LW uses: Imem, Add, Reg, ALU, signext, D-Mem

400 + 100 + 200 + 150 + 500 + 50 = 1400 ps

d) Because lw has the longest latency the clock cycle supporting the three instructions is: 1400 ps

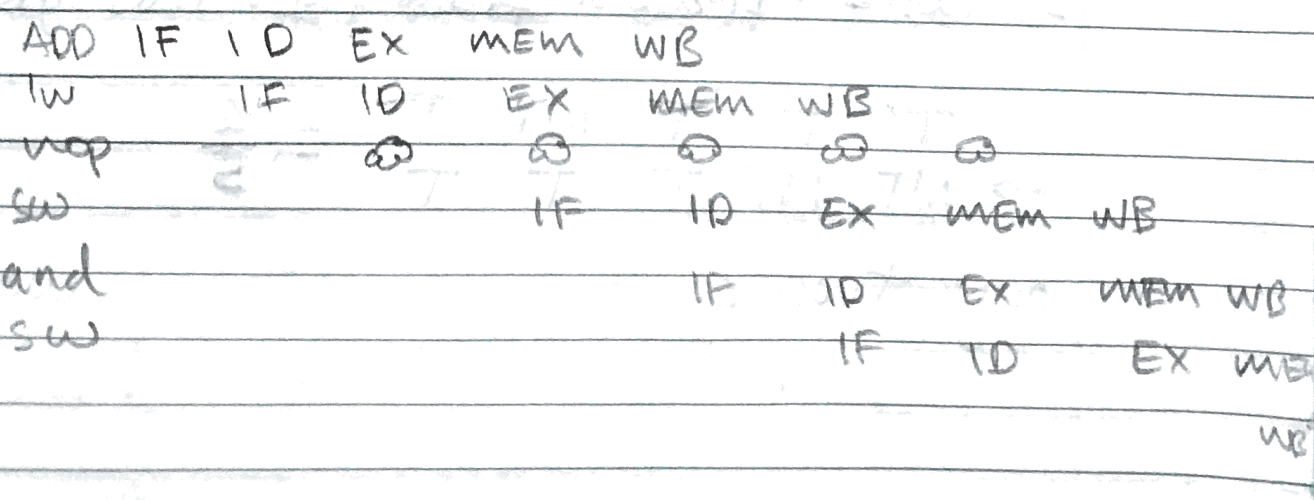
e) Because D-Mem is the most expensive this should be the data path component to have a reduced latency

2) True Dependency:

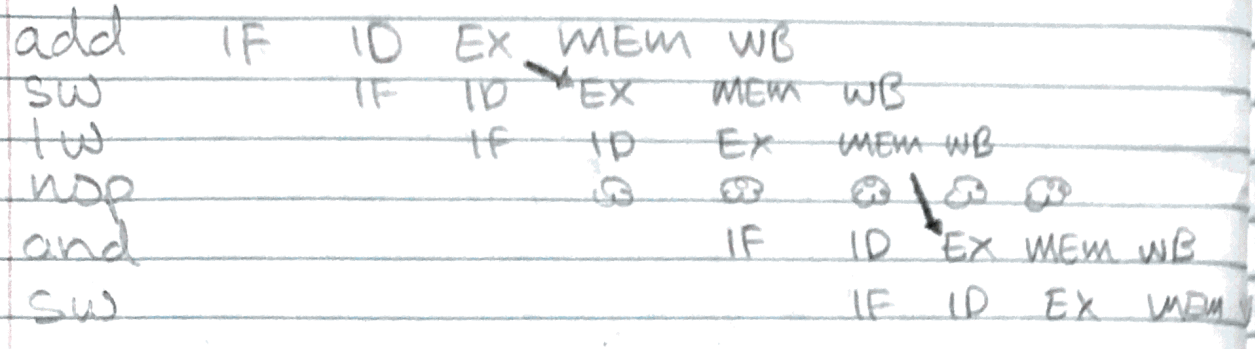
($8, I1, I2)
($8, I3, I4)
($8, I3, I5)

b)
```
add $8, $12, $10
nop
nop
sw $9, 0($8)
lw $8, 4($9)
nop
nop
and $12, $12, $8
sw $8, 0($9)
```

c)
```
add $1, $12, $10
lw $8, 4($9)
nop
sw $9, 0($1)
and $12, $12, $8
sw $8, 0($9)
```



② d)



③ a) ~~Always taken~~ accuracy

T T T NT T NT / T T T T T T = $\frac{4}{6} = \frac{2}{3}$ accuracy

For this sequence if the prediction is always taken gives 4 out of 6 correct hence the 2/3 accuracy 66%

always-not-taken.

T T T NT T NT / NT NT NT NT NT NT = $\frac{2}{6} = \frac{1}{3}$

b) Two bit predictor from Fig. 4.63 yields

T T T NT T
→ NT NT T T T = $\frac{2}{5}$

only two of five predictions were correct for this branches.

c) We find out by repeating the pattern

T T T NT T NT T T T NT T ...
NT NT T T T T T T T T T

B The first two results can be ignored since we want to know accuracy on an infinite number of branches Hence in general we get 4 out of 6 predictions correct since

... T T T NT T NT ...
T T T T T T

4/6 accuracy 2/3